NGST Systems Engineering Report

Thermal Subsystem 04

Title:	
Effects of Micrometeoroid Induce Shade Transmittance on OTA Temperatures	
Date: 5/4/98	Number: THSER04
Prepared by: Keith Parrish/NGST Thermal Systems Lead	
Concurrence: Paul Geithner/NGST Mission Systems Engineer	
References:	

Description

A thermal analysis was performed to investigate the effect of micrometeoroid damage on the OTA's temperature. Micrometeoroid damage has been estimated from preliminary investigations to cause a total shield area loss of up to 0.7% over NGST's ten year lifetime. Since the area loss will mostly consist of very small, ~<.005"diameter, randomly distributed penetrations, the effect on the sunshield's performance was modeled by introducing transmittance to the the sunshields optical properties in the geometric thermal models. Since the actual area loss due to micrometeoroid damage is still being investigiated, the effects of transmittance values of up to 2% were. The analyses assumed the six layer NASA yardstick shield configuration as the baseline.

Results Summary

Figure 1 illustrates the rise in OTA temperature as shade transmittance is introduced. The temperature rise is primarily due to the direct impingement of UV energy on shade layer two due to the transmittance of shade layer one. Very little direct UV energy of any significance makes it

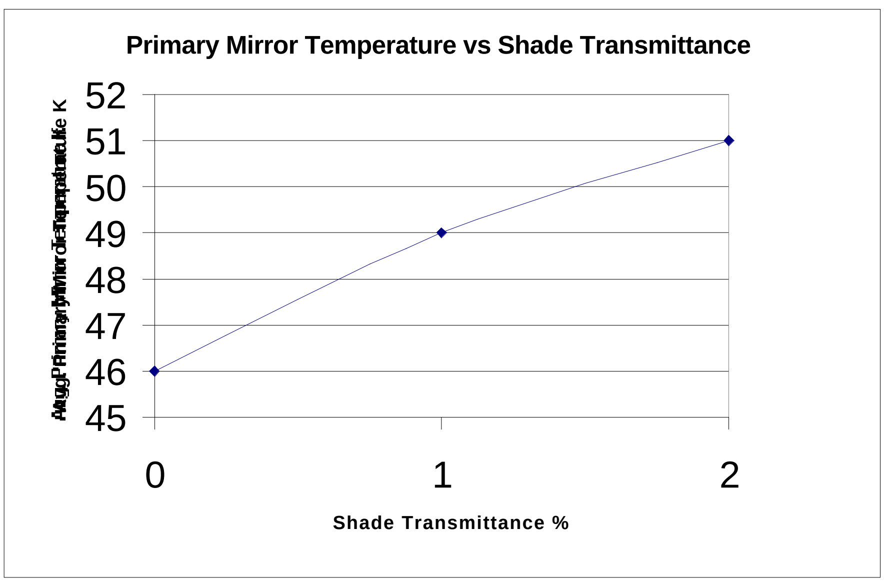

Figure 1

past shade layer three. The results indicate that although the effect is primarily small with transmittances under 1%, the effect needs to be accounted for and the estimated amount of damage needs to be better quantified. Severe thermal degradation could develop if shade damage area loss exceeds 2%. Shade damage combined with other degrading factors could raise the end of life primary mirror temperature beyond acceptable levels with the current yardstick baseline shield design.

Detailed Discussion

The analysis was performed by taking the NGST NASA yardstick end of life (EOL) six layer shield model and introducing transmittance into the optical properties of each layer of the shield. Each layer was introduced with the same transmittance percentage from zero up to two percent. Radiation interchange factors and solar heating rates were then calculated using TSS. Shield transmittance was allowed in both the UV and IR wavelengths. Shade transmittance allows UV solar energy to pass from the sun side layer to the next and so on. With a 1% transmittance, 1% of 1421 W/m^2 or 14.21 W/m^2 is allowed to impinge on shade layer two. Since shade layer two is low emittance, 0.03, and has relatively little view to space, shade layer two aproaches shade layer one temperature. Since the amount of direct UV energy that passes on to shade layer three is reduced by 99%, the temperature effect on shade layer three is negligible. However, the increased temperature of shade layer two, causes the last shade layer, layer six, to increase in temperature approximately 10 K for the 1% case yielding the 3 K increase in the primary mirror’s average temperature. The small transmittance also allows radiation exchange between non-adjacent layers, although this effect is extremely small when compared to the direct exchange from layers which directly view each other. The analysis assumed fully diffuse shield layer optical properties. If the number of sunshield layers is increased, then the effects of shade transmittance will diminish.